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BULLETIN
OF THE
AMERICAN GEOGRAPHICAL SOCIETY.

Vol. XXXIX

1907.

No. 3

POSITION OF HUBBARD GLACIER FRONT IN 1792
AND 1794.*

BY

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From the accounts presented in the reports of the Malaspina and Vancouver expeditions, the late Professor I. C. Russell drew the conclusion that in 1792 and 1794 the front of the Hubbard Glacier was approximately five miles farther down Disenchantment Bay than it is at the present time, reaching Haenke Island.† This interpretation of the descriptions in these reports has been quite generally admitted. It is, for example, accepted by Dr. G. K. Gilbert in his description of the glaciers of Yakutat Bay.‡

Our work of two seasons in the Yakutat Bay Inlet has led us to question this interpretation of the descriptions of these two early explorers. In this field work we have discovered three lines of opposing evidence; though it cannot be claimed that, by themselves, these are absolutely fatal to the interpretation.

The first objection is in the character of the vegetation. So far as we could see, there is no difference in the maturity of plant development in Disenchantment Bay north and south of Haenke Island. This is quite in contrast to the condition in Nunatak Fiord and a large part of Russell Fiord, which the Nunatak Glacier, with tributaries, has occupied quite recently and probably within the last century. Here the vegetation is so immature as to prove conclusively the recency of ice occupation. There is no such evidence in Disenchantment Bay, although the conditions for plant growth are no more favourable there than in Russell Fiord.

* For a map showing the location of places referred to in this paper, see this BULLETIN, Vol. XXXVIII, 1906, opposite p. 145.

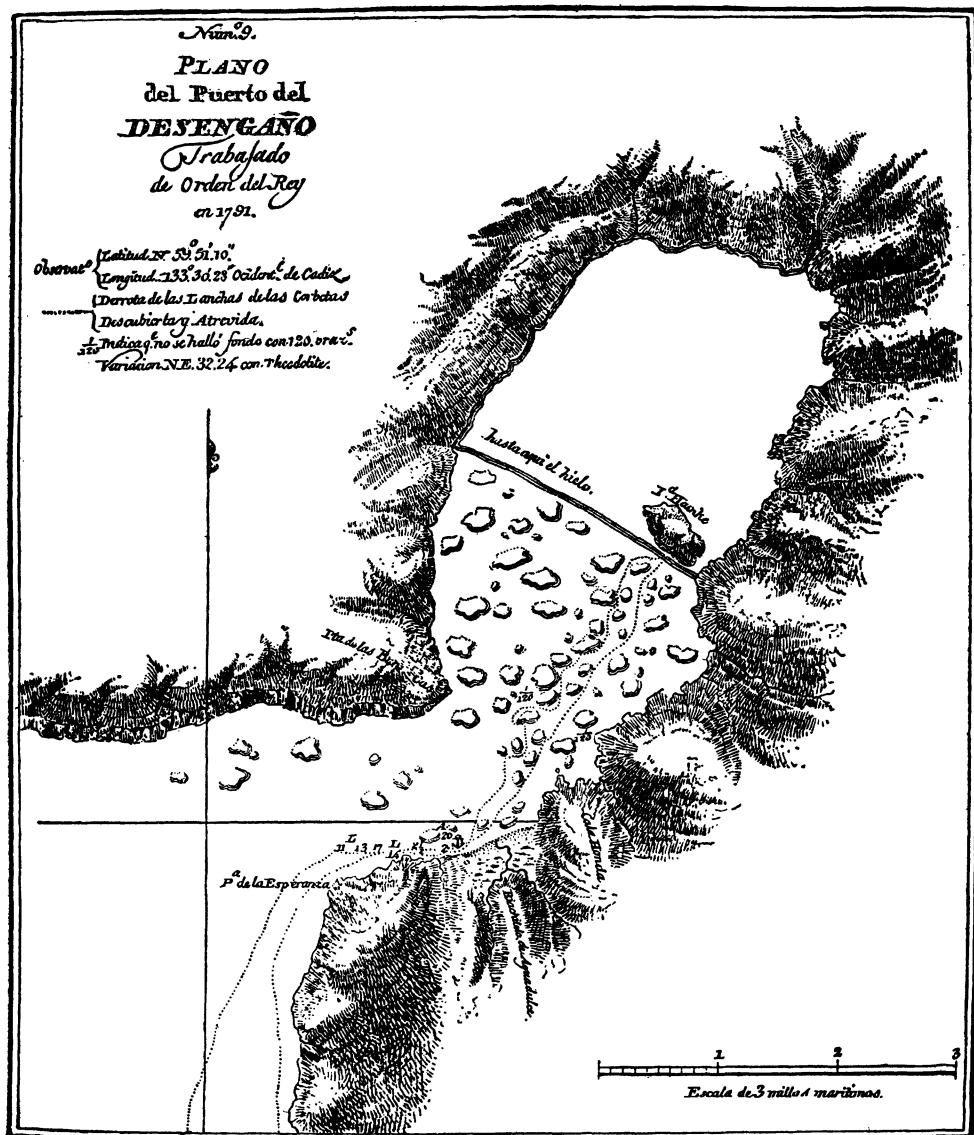
† Nat. Geo. Mag., Vol. III, 1891, pp. 62-68.

‡ Harriman Alaska Expedition, Vol. III, Glaciers and Glaciation, 1904, pp. 48-49.

A second objection to the belief in such a recent extension of Hubbard Glacier down as far as Haenke Island is the absence of lacustrine deposits in that part of Russell Fiord between Osier Island and Cape Enchantment. When the Hubbard Glacier extended down to Haenke Island, it must, at least in its retreating stages, have dammed up this part of Russell Fiord, forming a lake, the shore-lines and clay deposits of which ought to be easily recognized if they were formed no more than a century ago. Such shore-lines are clearly recognizable at the southern end of Russell Fiord, where they were formed in the lake which was ponded back by the ice dam of the expanded Nunatak Glacier; but they were not discovered in lower Russell Fiord, where they would be expected if the Hubbard Glacier had so recently extended down Disenchantment Bay. If ice from the Nunatak Glacier is supposed to have then filled this part of Russell Fiord, thus preventing lacustrine deposits, that fact should be indicated by the vegetation; but this is not the case, for the vegetation in this part of the fiord is as mature as that in Disenchantment Bay.

A third objection is furnished by the shore-lines in Disenchantment Bay. These have been recently raised above sea-level during the uplift accompanying the earthquakes of 1899, and are therefore very clearly exposed to view. They are strongly developed all *around* Haenke Island and on the mainland from there to Osier Island. They are altogether too strongly developed for wave work of a single century; and, moreover, those toward the south have no appearance of greater maturity of development than those toward the north, as young shore-lines should, with progressive ice retreat. In the six years since the uplift, even the competent iceberg waves have made no notable cuts in the bed rock at the new stand of the land, not even having erased delicate glacial striæ along much of the new coast-line. It seems hardly credible, therefore, even with much more competent iceberg waves, that in less than nineteen times six years (1794 to 1899) rock benches two or three hundred feet wide should be planed back by the waves, as must have been the case if we accept the current belief that the Hubbard Glacier occupied the site of these benches a little over a century ago.

These considerations have led us to examine critically the Malaspina and Vancouver accounts, and the result has forced us to question the evidence even more strongly. It is certainly not a *necessary* conclusion from the descriptions; and for the reasons stated below it seems hardly a probable one.



MAP OF DISENCHANTMENT BAY, AFTER MALASPINA.

FIG. 1.—REDUCED FROM RUSSELL'S REPORT.

Malaspina's account is as follows:*

An observatory was established on shore, and some absolute altitudes were taken in order to furnish a basis for the reckoning of the watches; but the great concourse of Indians, their importunity and thievishness, made it necessary to transfer all the instruments on board. Still the latitude was determined, the watches were regulated, the number of oscillations made by the simple pendulum was observed, and the height of Mount St. Elias was measured, being 6,507.6 varas (17,847 feet) above sea-level. The launches being ready, put to sea on July 2 with the commander of the expedition, in order to reconnoitre the channel promised by the opening, similar to that depicted by Ferrer Maldonado in his voyage; but the small force of the tide noticed at the entrance, and the indications of the natives, made it plain not only that the desired passage did not exist there, but that the extent of the channel was very short; which was also rendered evident by the perpetual frost covering the inner west shore. The launches anchored there, having penetrated into the channel with great difficulty, the oars being clogged by the floating masses of snow; they measured a base, made some marks, gathered various objects and stones for the naturalists, and, having reached the line of perpetual frost, returned to the bay where they had anchored. (†) They there observed the latitude to be $59^{\circ} 59' 30''$, and six azimuths of the sun, which gave the variation of the needle as $32^{\circ} 49'$. Before leaving that anchorage the commander buried a bottle with record of the reconnaissance and possession taken in the name of the king. They called the harbor Desengaño, the opening Bahia de las Bancas, and the island in the interior Haenke, in memory of D. Tadeo Haenke, botanist and naturalist of the expedition. On the third day they set out on their voyage to Mulgrave, where they arrived on the 6th, after reconnoitring various channels and islands north of that port and mapping them.

In this account it is stated that there was "perpetual frost covering the inner west shore;" that the oars were "clogged by the floating masses of snow;" and that, "having reached the line of perpetual frost," they returned. It seems scarcely probable that any explorers would have been hardy enough to really "reach the line of perpetual frost," if by that it was meant that they had reached the 250-foot cliff of a tidal glacier, from which icebergs were being constantly discharged. Had they done so it does not seem conceivable that they would have been content with this tame description of so remarkable an experience; especially in view of the fact that elsewhere they have reported the most trivial experiences and observations. To have seen a solid wall of ice three miles long and two-hundred and fifty feet high, from which icebergs were being constantly discharged, the air filled with sounds like thunder, and the waters of the fiord disturbed by huge iceberg waves, would have been an experience which one would normally expect recorded by at least a word or two, if not by vivid description, especially by men from southern Europe, where tidal glaciers are unknown.

The map accompanying the Malaspina report bears the words "hasta aqui el hielo," meaning "ice up to here." The ice region is bounded by three parallel lines, not hachured to indicate a cliff, as has been done in other parts of the map where abrupt cliffs are present. There is no special indication of a change of conditions be-

* Quoted from Russell's paper, *Nat. Geog. Mag.*, Vol. III, 1891, pp. 64-65, where Malaspina's account is translated by Robert Stein. For the original see "Relacion del viage hecho por las goletas Sutil y Mexicana en el año de 1792, etc. (Por Don Dionisio Alcalá Galiano.) Madrid, 1802, with Atlas. Pp. CXII-CXXI.

† On the coast of the mainland east of Knight Island.—I. C. R.

tween the water of outer Disenchantment Bay and the ice-covered part of the inner bay; and the eastern shore-line is drawn as if there were no break in conditions on the two sides of the "ice up to here" line. The symbol of these lines, which it is noteworthy is the same as that used to indicate individual icebergs, is extended up the west shore, and on to the land as a river, as if the chronicler thought the ice was derived from the land. The eastern shore-line, on the other hand, is drawn in with much detail, exactly as is the shore-line farther down the bay below the ice limit. If a great glacier then existed here, the map maker must stand convicted of gross untruthfulness,



FIG. 2.

for he could scarcely have failed to see the striking difference between a water contact and an ice contact with the land. That he so clearly draws a water contact is fair indication that this is what he really saw there.

It is noteworthy that the ice line is drawn as extending entirely outside of Haenke Island. Had the glacier front actually been down this far at that time, the ice must have ridden around, and at least partly over Haenke Island. Moreover, to have completely united the two tongues on the southern side of the island would have necessitated a much greater advance of the glacier in the deeper inlet, on the west side of Haenke Island, than the map indicates. That it was not glacier ice that they encountered immediately south of Haenke Island is practically proved by their statement that "they measured a base, made some marks, and gathered various

objects and stones for the naturalists." Their map shows the route, and it is evident that it was Haenke Island on which this was done. Had a glacier completely wrapped around this island they could not have landed there.

These considerations lead to the question whether these explorers, in speaking of "perpetual frost," meant anything more than a fairly compact mass of floating ice. Even at the present day the entire fiord at Haenke Island is frequently obstructed from side to side with a massive accumulation of floating ice, through which it is exceedingly difficult and even dangerous to force a small boat; and the "inner west shore" is almost all the time enclosed in a floating mass of ice, which might well be called "perpetual frost."

In the second expedition to Yakutat Bay, in 1906, the captain of the steamer *Santa Ana* had instructions to land the senior author and his party on the west side of the inlet near the entrance to Disenchantment Bay. Although accustomed to navigating the ice-laden waters of Icy Straits, and other Alaskan inlets in which there is floating ice, the captain refused point blank to run the risk of pushing even his small boats through the half mile of ice which hugged the "inner west shore" of the Bay. Moreover, he went so far as to say that one could not push a boat through this ice. We proved this not to be the case on the next day when we ourselves moved to the west shore through the packed ice. But it took several hours to make the passage of a little over half a mile, for the ice was packed together so closely that it was necessary first to push the bergs away and then to pole the boat through the opening, which closed again as soon as the boat had passed. At that time of year, the last week in June, which was only a week earlier than the season of Malaspina's visit (July 2nd), the smaller pieces of floating ice were frozen together in great cakes, which it was necessary to first break apart before we could move forward.

Frederick Funston, now Brigadier General of the United States Army, writing of his experiences in 1892 says: * "Canoeing in Disenchantment Bay was attended with much labor and no little peril, as we were constantly in danger of being crushed in the floating ice which filled the bay at nearly all times." This is the impression produced upon most observers, especially if it is their first experience with massive accumulations of glacier ice.

It seems not at all improbable, therefore, that if Malaspina's crew, from southern Europe, had encountered no worse ice condition than is common at the present time, especially in the early

part of the summer season, they would have decided that further progress was impracticable, and would have turned back, with the report that there was "ice up to here."

The description in Vancouver's report* of the conditions discovered by Peter Puget in 1794 is no more convincing than the Malaspina account. This report states that boats sent up to explore the inlet found it

closed from side to side by a firm and compact body of ice, beyond which at the back of the ice a small inlet appeared to extend N. 55° E. about a league.



FIG. 3.

(FIGS. 2 AND 3).—VIEWS IN THE FIELD OF FLOATING GLACIER ICE IN DISENCHANTMENT BAY BELOW HAENKE ISLAND. IN FIG. 3 THE TURNER GLACIER IS SEEN IN THE BACKGROUND ON THE LEFT, THE HUBBARD GLACIER ON THE RIGHT.

As in the case of the Malaspina description, it seems strange that there should be no mention of the remarkable features connected with a glacier front, if such an ice cliff then stretched across Disenchantment Bay at Haenke Island. The most trivial circumstances are mentioned in these volumes, and yet so striking a phenomenon as an ice cliff, with all the accompanying features of grandeur, was dismissed in the words "firm and compact body of ice."

A still greater difficulty in the way of accepting the conclusion

* *A Voyage of Discovery to the North Pacific Ocean, and Round the World, 1790-1795.* New edition, 6 vols., London, 1801, Vol. 5, p. 389.

that the glacier then extended this far, lies in the mention of "a small inlet" "back of the ice," and some three miles or more in length. It would be very difficult to account for an inlet in such a position if this ice was really meant for the extended Hubbard and Turner glaciers. But if by "firm and compact body of ice" he means floating ice, or frozen ice cakes (Puget's visit was also in the first week of July), the inlet is easily understood, for at present it very commonly happens that, while much of the bay is shut in by ice, there is a narrow lane of relatively clear water between Haenke Island and the mainland, and from there northeastward toward Osier Island.

Later in the Vancouver report* there is a sentence which leads us to believe that our interpretation of his meaning in the use of the words "firm and compact body of ice" is correct. Describing the experiences of Mr. Whidbey in Cross Sound, near Dundas Bay, he says:

This made Mr. Whidbey apprehensive that the still apparent connected body of ice from side to side would at length oblige him to abandon his researches by this route, unless he should find it possible to force a passage through this formidable obstruction.

If he had this fear in the relatively small accumulations of ice in Cross Sound, Puget might well have had enough more fear in the massive ice fields of Yakutat Bay to report the ice as "firm and compact," and to "abandon his researches."

That the Hubbard Glacier has recently been much further down the fiord than at present, and that this advance brought it down beyond Haenke Island, there is no question. All facts in the field indicate this, and, in addition, that up to the present time the glaciers have been in a state of recession for a long period. Doubtless a century ago both the Turner and Hubbard Glaciers were further out in the fiord than at present; and if that were the case, it is probable that there was then even more floating ice in the bay than now. But that in 1792 and 1794 the ice front was actually down to the south side of Haenke Island seems to us not to be demonstrated by the evidence presented in the reports of the Vancouver and Malaspina expeditions.

It is a disappointment to lose this case of what at first seemed to be an authentic instance of marked historic glacial retreat, but the evidence, as we interpret it, forces us to believe that this is necessary.